which, as before, is incident at an angle of 18° on the plate. In this position, the light falling perpendicularly on the narrow face, passes through it unbroken, and being within the glass reflected from the rulings, the coloured pictures of all the twelve systems are now exhibited in the microscope. If the colours which these systems now show, and which have been formed *in the glass*, be compared with the former colours *in the air*, the system F, which is deep red, harmonizes with the system A in the air spectrum, and the systems G, H, I, K, L and M in the glass spectrum, according to their order and colour, correspond to the systems B, C, D, E, F and G in the air spectrum; and the author considers that the comparison of the foregoing values in the systems—

A and F,	E and K,
B and G,	F and L,
C and H,	G and M
D and I,	

shows that the lengths of undulation for the same colour in the air and in the glass are in the ratio 1·53 to 1, which is exactly the index of refraction of this glass. He further remarks, that, as the same period of undulation belongs to the same colour, the velocities of propagation in air and in the glass must be in the ratio of the mean value of the distances of the lines in the first seven systems, A, B, C, D, E, F, G, to the mean value of the distances of the lines in the last seven systems, F, G, H, I, K, L, M, or as 1·53 to 1; and that both results agree perfectly with the deductions from the wave-theory of light. In conclusion, the author points out the extraordinary degree of accuracy required in drawing these lines. It is stated that if inequalities amounting only to ·000002 line occur in the systems F, G, H, I, K, L, M, stripes of another colour will appear in them; and if the distance of the lines in M be diminished by that quantity, all colour disappears.

The following communication was also read:—

Extract of a letter from Professor Kämtz to Lieut. Colonel Sabine, on "Corrections of the Constants in the general theory of Terrestrial Magnetism." Received April 3, 1851.

Translation.

Dorpat, $\frac{4}{16}$ January 1851.

From the active zeal with which you pursue the phenomena of terrestrial magnetism, and collect all the facts which can conduce to the elucidation of this difficult subject, I think that some researches with which I have occupied myself will not be wholly uninteresting to you; and I therefore address you the following lines, which I have also permitted myself to write in my own language.

Some years ago I employed myself in endeavouring to correct the constants which Gauss has given for the earth's magnetism. The process I adopted was by considering the horizontal and vertical components separately; but when I learned that Erman had the

same work in hand, I left mine unfinished. I did not then possess the Reports of the British Association, as it was not until this last summer (1850) that they were obtained here, and when I had seen Erman's results, I at once decided on taking up my work afresh. I have made use of all the data I could procure, and have thus been able to determine the component Z at above 1400 places, including a series of observations which I had myself made from 1847 to 1849 in Liefland, Esthonia, Finland, Norway, and on the route from Archangel to Petersburg. I have as far as possible reduced all determinations to the epoch of 1830. A calculation of the several observations by the method of least squares would have required an entire life; I therefore preferred following the same path as Gauss; in doing this, however, I soon discovered that the 5th order could not be neglected; and I then obtained the following values:—

$g^{1,0} = 927{\cdot}9$	$g^{1,1} = 89{\cdot}8$	$h^{1,1} = -163{\cdot}7$	$g^{2,2} = 2{\cdot}5$	$h^{2,2} = -37{\cdot}3$
$g^{2,0} = -6{\cdot}4$	$g^{2,1} = -140{\cdot}6$	$h^{2,1} = -14{\cdot}1$	$g^{3,2} = -86{\cdot}9$	$h^{3,2} = -17{\cdot}2$
$g^{3,0} = -51{\cdot}8$	$g^{3,1} = 112{\cdot}3$	$h^{3,1} = 48{\cdot}5$	$g^{4,2} = -41{\cdot}3$	$h^{4,2} = 43{\cdot}4$
$g^{4,0} = -83{\cdot}2$	$g^{4,1} = -103{\cdot}2$	$h^{4,1} = -18{\cdot}2$	$g^{5,2} = -96{\cdot}5$	$h^{5,2} = -10{\cdot}0$
$g^{5,0} = 14{\cdot}3$	$g^{5,1} = -115{\cdot}1$	$h^{5,1} = 72{\cdot}8$		

$g^{3,3} = -4{\cdot}4$	$h^{3,3} = -25{\cdot}1$	$g^{4,4} = 3{\cdot}9$	$h^{4,4} = 4{\cdot}3$
$g^{4,3} = 18{\cdot}8$	$h^{4,3} = 18{\cdot}6$	$g^{5,4} = {\cdot}0$	$h^{5,4} = 2{\cdot}8$
$g^{5,3} = 3{\cdot}3$	$h^{5,3} = -1{\cdot}6$		
		$g^{5,5} = {\cdot}0$	$h^{5,5} = {\cdot}0$

A comparison will show you that these quantities agree much better with Gauss's than Erman's do; and this is also true in respect to the agreement with the observations, especially in the high south latitudes. Thus there was found—

	Latitude.	Longitude.	Inclination.	Force.
	° ′	° ′	° ′	
	−69 54	179 55	−84 30	1999
	−69 52	180 04	−83 34	1994
Means	−69 53	180 0	−84 02	1996·5

Z = −1985·8 for −70° and 180°; Gauss found −2193·5; Erman −1781·1; my calculation gives −2009·3. My constants also still require a small correction. I do not however mean to examine this at present, but propose first to consider the horizontal component, in order to satisfy myself previously whether both components depend upon the same constants or not. The probable error of a single determination is nearly 19; and to show the degree of agreement, I subjoin the following table. As in forming it I merely took from my large table every 10th observation in the order of succession, you will not be surprised at finding unimportant places, whilst others of greater note in their vicinity are omitted: it may suffice however for the present purpose. The quantities given are the differences between the observed and calculated vertical intensity.

Stations.	Lat. N.	Long. E.	Δ Z.	Observers.
	° ′	° ′		
1. Fairhaven, Spitzbergen	79 40	11 40	− 24·1	Sabine.
11. Tromsöe.................	69 39	18 55	+ 31·2	Keilhau.
21. Tukansk. Isl............	68 4	39 35	− 39·1	Reinicke.
31. Grundsät	60 56	11 35	+ 39·8	Hansteen.
41. Sundsvall	62 22	17 16	+ 2·5	Hansteen.
51. Abo	60 27	22 18	− 15·7	Hansteen.
61. Danzig	54 21	18 38	+ 31·0	Ericksen.
71. Doskino..................	56 9	43 34	− 32·8	Erman and Hansteen.
81. Perm	58 1	56 14	− 30·0	Erman and Hansteen.
91. Tiumen	57 10	65 27	− 13·4	Erman and Hansteen.
101. Wandiask	66 16	65 10	− 27·7	Erman.
111. Tschuluim..............	55 6	81 14	− 24·6	Erman.
121. Botowsk.................	55 10	105 22	− 3·7	Erman.
131. Monachanowa	50 58	106 29	+ 6·8	Hansteen.
141. Nowaja River	72 7	95 25	+ 22·3	Middendorf.
151. Progromnoi	52 30	111 3	+ 11·8	Fuss.
161. Nalaicha.................	47 47	107 18	+ 9·8	Fuss.
171. Chapchaktu	46 2	108 35	− 13·0	Fuss.
181. Zackildack..............	42 48	114 17	+ 13·5	Fuss.
191. Gaschun.................	44 23	111 19	− 9·8	Fuss.
201. Arki	60 6	142 20	+ 1·2	Erman.
211. Sitka	57 3	224 34	− 2·2	Lütke, Erman, Belcher.
221. F. Dunvegan	55 56	241 26	+ 22·7	Lefroy.
231. Frog Portage	55 28	256 30	+ 9·1	Lefroy.
241. York Factory...........	57 0	267 34	+ 4·9	Lefroy.
251. Fort Alexander	50 37	263 39	+ 13·4	Lefroy.
261. Devil's Drum Island ...	53 19	259 20	− 22·7	Lefroy.
271. Cape Disappointment...	46 16	236 4	− 34·2	Douglas.
281. Lac à la Pluie	48 32	267 4	+ 19·9	Lefroy.
291. Fort à la Cloche	46 7	277 35	− 19·7	Lefroy.
301. Portage Ecarté	48 25	270 15	+ 4·8	Lefroy.
311. Chat Falls	45 26	283 28	+ 22·8	Lefroy.
321. Pointe aux Chênes ...	45 37	285 5	+ 7·7	Lefroy.
331. Lake Nipissing	46 13	280 1	+ 16·7	Lefroy.
341. Waterville	44 33	293 23	+ 11·9	Keely.
351. Dubuque's Town	42 29	269 37	+ 20·8	Locke.
361. St. Mary's	40 32	275 41	+ 31·9	Locke.
371. Detroit	42 25	277 0	+ 24·0	Loomis, Younghusband, Locke, Lefroy.
381. Alleghany Summit ...	40 27	281 50	+ 29·3	Locke.
391. Utica	43 7	284 47	+ 27·2	Loomis, Locke.
401. Portland.................	43 41	289 40	+ 14·5	Locke.
411. St. Louis	38 38	269 56	+ 35·8	Locke, Loomis, Nicollet.
421. Paoli	38 5	273 35	+ 30·7	Locke.
431. Columbus	39 57	276 57	+ 11·9	Locke.
441. Lerwick	60 9	358 53	+ 46·8	Ross.
451. Loch Slapin	57 14	353 58	+ 30·4	Sabine.
461. Braemar..................	57 1	356 35	+ 16·2	Sabine.
Edinburgh	....	....	+ 8·8	
471. Valencia..................	51 56	349 43	+ 8·5	Sabine, Ross.
481. Enniskillen	54 21	352 22	+ 25·6	Lloyd.
491. York	53 58	358 54	+ 22·5	Phillips, Ross.
501. Calderstone	53 23	357 7	+ 17·7	Phillips.
511. Castleton	54 4	355 20	+ 22·7	Phillips.
Dublin	....	....	+ 15·2	All Observers.
521. Fermoy	52 7	351 44	+ 13·5	Sabine.
531. Clifton	51 27	357 25	+ 16·4	Lloyd, Ross.

Stations.	Lat. N.	Long. E.	Δ Z.	Observers.
	° ′	° ′		
541. London	51 31	359 53	+ 21·9	All Observers.
551. Salisbury	51 4	358 12	+ 18·3	Lloyd, Ross.
561. Dover	51 8	1 19	+ 19·7	Sabine.
571. Fontainebleau	48 24	2 38	+ 11·0	Fox.
581. Nimes	43 50	4 20	− 3·8	Fox, Humboldt.
591. Malaga	36 44	355 36	− 13·4	Norwegian Officers.
601. Prague	50 5	14 27	+ 15·5	Keilhau, Kreil.
611. Berne	46 57	7 25	+ 12·0	Fox.
621. Seelau	49 32	15 17	+ 21·6	Kreil.
631. Rome	41 54	12 26	+ 5·0	Humboldt, d'Abadie, Quetelet.
641. Milo	36 43	24 27	+ 19·6	Norwegian Officers.
651. San Diego	32 41	242 27	− 70·6	Belcher.
661. At sea	47 7	346 54	− 0·4	Sulivan.
671. At sea	44 22	330 54	− 18·3	Erman.
681. At sea	30 0	318 5	− 4·3	Sulivan.
Teneriffe	28 27	343 43	− 0·4	Humboldt, Freycinet, Duperrey, Sabine, Bethune, Wickham, Sulivan.
691. At sea	21 32	316 43	+ 21·3	Sulivan.
701. At sea	23 12	238 9	− 61·2	Erman.
711. Socorro Island	18 43	249 6	+ 28·0	Belcher.
721. Ulean	7 22	143 57	− 10·8	Lütke.
731. At sea	8 55	235 48	− 27·8	Erman.
741. La Guayra	10 36	292 54	+ 2·6	Humboldt.
751. Morales	8 15	286 0	− 7·0	Humboldt.
761. At sea	10 7	319 51	+ 48·9	Sulivan.
771. St. Thomas, Fernando Po, Isla das Rolhas	1 23	7 20	− 35·8	The secular change at this station is uncertain; I take the mean of the inclinations by Sabine and Allen; the force at St. Thomas, from Sabine.
781. At sea	3 47	162 59	+ 8·2	Lütke.
791. At sea	− 2 2	236 4	+ 31·7	Lütke.
801. Pasto	1 13	282 39	− 13·0	Humboldt and Bousingault.
811. At sea	5 45	331 9	+ 8·4	Erman.
821. At sea	5 37	341 3	+ 10·8	Dunlop.
831. Pulo Kumpal	− 2 44	110 7	− 16·8	Belcher.
841. Shell Rock	− 1 57	136 21	+ 1·4	Belcher.
851. Gonzanama	− 4 13	280 27	− 4·5	Humboldt.
861. At sea	− 1 10	223 32	− 19·9	Erman.
871. Tomependa	− 5 31	281 24	+ 10·1	Humboldt.
881. Huaura	− 11 3	282 14	+ 12·9	Humboldt.
891. At sea	− 0 27	324 44	+ 52·2	Sulivan.
901. At sea	− 8 10	339 50	− 21·1	Dunlop.
911. At sea	− 11 54	214 37	− 9·4	Erman.
921. At sea	− 13 9	251 20	+ 57·0	Lütke.
931. Bow Island	− 18 5	219 7	+ 7·5	Belcher.
941. At sea	− 19 56	325 5	− 20·7	Sulivan.
St. Helena	− 15 55	354 17	+ 14·7	All Observers.
951. At sea	− 26 25	49 12	− 17·1	Moore and Clerk.
961. At sea	− 21 54	53 0	− 20·0	Moore and Clerk.
Mauritius	− 20 9	57 31	− 0·5	Duperrey, Fitzroy, Moore and Clerk.
971. At sea	− 22 41	69 54	− 26·7	Dayman.
981. At sea	− 22 38	76 10	− 17·4	Dayman.
991. At sea	− 22 34	80 10	− 22·1	Dayman.

Stations.	Lat. S.	Long. E.	Δ Z.	Observers.
	° ′	° ′		
1001. At sea	24 17	94 6	− 7·5	Moore and Clerk.
1011. At sea	21 51	268 5	+ 19·0	Lütke.
1021. At sea	29 53	313 43	− 19·3	Erman.
1031. At sea	38 44	0 16	− 7·7	Dunlop.
1041. At sea	35 48	18 47	− 25·8	Erebus and Terror.
1051. At sea	32 17	29 34	+ 0·6	Dayman.
1061. At sea	38 11	22 0	− 29·9	Erebus.
1071. At sea	39 16	30 27	− 10·7	Dunlop.
1081. At sea	33 47	111 4	+ 31·3	Dayman.
1091. At sea	35 5	117 56	− 7·1	Moore and Clerk.
1101. At sea	42 35	125 40	+ 51·3	Smith.
Sydney	....	....	+ 39·0	All Observers.
			+ 17·7	(British only).
1111. At sea	33 38	163 42	− 33·2	Erebus.
1121. Bay of Islands	35 16	174 0	− 8·4	Duperrey, FitzRoy, Erebus.
1131. Valdivia	39 53	286 31	+ 41·3	FitzRoy.
1141. At sea	44 4	312 1	+ 9·1	Sulivan.
1151. At sea	37 37	353 36	− 36·3	Dunlop.
1161. At sea	41 47	26 38	− 16·7	Erebus.
1171. At sea	46 28	52 31	− 4·0	Erebus. Maximum of probable error. There are great anomalies in this meridian.
1181. At sea	48 40	68 58	− 55·5	Erebus.
Kerguelen Island	48 41	68 54	− 11·9	Erebus.
1191. At sea	47 39	103 42	− 23·4	Erebus.
1201. At sea	47 34	124 43	− 109·6	Erebus.
Hobart Town	42 53	147 24	+ 41·8	All Observers.
1211. Bass's Strait	40 28	151 35	+ 11·5	Wickham.
1221. At sea	41 49	183 41	− 18·3	Erebus.
1231. At sea	49 23	188 29	·0	Erebus.
1241. At sea	53 57	6 5	− 4·1	Moore and Clerk.
1251. At sea	54 55	132 50	− 53·8	Erebus.
1261. At sea	57 54	170 25	+ 40·4	Erebus.
1271. At sea	53 1	205 8	− 18·3	Erebus.
1281. At sea	58 39	213 17	− 6·7	Erebus.
1291. At sea	60 21	237 54	− 19·0	Erebus.
1301. At sea	58 25	279 44	+ 10·8	Erebus.
Port Famine	53 38	289 2	+ 4·6	King and FitzRoy.
1311. At sea	46 0	299 50	− 49·2	Sulivan.
Falkland Islands	51 33	301 55	+ 41·3	All Observers.
1321. At sea	61 10	9 5	+ 15·9	Moore and Clerk.
1331. At sea	66 33	36 48	+ 17·5	Moore and Clerk.
1341. At sea	66 24	40 30	+ 8·1	Moore and Clerk.
1351. At sea	60 50	87 41	+ 10·1	Moore and Clerk.
1361. At sea	65 9	143 7	− 52·5	Erebus.
1371. At sea	64 41	162 34	− 10·5	Erebus.
1381. At sea	61 34	170 40	+ 26·7	Erebus.
1391. At sea	67 14	188 6	+ 18·4	Erebus.
1401. At sea	65 18	191 39	+ 28·5	Erebus.
1410. At sea	67 16	202 13	+ 30·4	Erebus.
1411. At sea	61 15	213 54	+ 22·2	Erebus.
1412. At sea	62 38	212 44	+ 3·4	Erebus.
1421. At sea	70 23	174 50	− 10·2	Erebus.
1431. At sea	72 58	189 50	+ 21·0	Erebus.
1441. At sea	77 6	192 31	− 8·0	Erebus.
1444. At sea	77 47	197 25	+ 23·2	Erebus.

I think the agreement pretty good for a calculation which I still expect to correct in some degree; it is also to be remarked that I

have taken the results of all observers, and that their determinations often differ considerably from each other at the same place. Unfortunately I could not make use of the two important determinations of the Euphrates Expedition for want of the Inclination.

As you collect everything that can serve towards a final determination of the elements, I permit myself to subjoin the following data which are still partly unpublished.

Stations.	Lat. N.	Long. E.	Date.	Inclination.		Horizontal Force.	Total Force.	Vertical Force.		
				Observed.	Reduced to 1830.			Observed.	Calculated.	Difference.
Uellenorm	58° 19′	26° 43′	1847.	70° 9′·8	70° 38′·0	473·7	1396·0	1317·0	1317·6	− 0·6
Dorpat*	58 23	26 44	1847 to 1850.	70 50·7	71 19·9	465·4	1421·9	1347·1	1318·0	+29·1
Kardis	58 51	26 17	1847.	70 17·1	....	471·6				
			1849.	17·5	....	467·1				
				70 17·3	70 48·3	469·3	1388·4	1311·2	1323·2	−12·0
Revel	59 35	24 43	1847.	70 54·4						
			1849.	45·8						
				70 50·1	71 21·1	454·4	1384·2	1311·5	1330·7	−19·2
Nawast	58 35	25 34	1848.	70 41·0	71 12·0	454·7	1374·5	1301·2	1318·6	−17·4
Werder†	58 35	23 40	1848.	69 31·6	70 2·6	484·6	1385·4	1302·2	1315·9	−13·7
Arensburg	58 15	22 25	1848.	70 51·1	71 22·1	455·5	1388·8	1316·0	1309·1	+ 6·9
Kabbil	58 20	22 40	1848.	71 9·3	71 40·3	437·6	1354·8	1286·1	1310·4	−24·3
Pernaw	58 22	24 32	1848.	70 36·3	71 7·3	458·4	1380·1	1305·9	1313·9	− 8·0
Tammiss	58 21	24 33	1848.	70 24·5	70 55·5	459·0	1368·8	1293·6	1313·7	−20·1
Kurkundt	58 8	24 59	1848.	69 47·9	70 18·9	476·2	1378·7	1298·0	1311·8	−13·8
Helsingfors	60 10	24 57	1847.	71 21·7	....	444·3				
			1849.	19·7	....	7·6				
				71 20·7	71 51·7	446·0	1394·3	1325·0	1339·0	−14·0
Bollstad	60 9	24 13	1847.	71 30·2	71 59·4	441·4	1391·4	1323·2	1338·0	−14·8
Kyrkstad	60 10	24 5	1847.	71 21·9	71 51·1	442·6	1385·1	1316·2	1338·0	−21·8
Lambola	60 15	23 10	1847.	71 28·9	71 58·1	442·7	1393·8	1325·4	1335·8	−10·4
Nukari	60 22	24 55	1847.	71 40·3	72 9·5	440·8	1401·8	1334·3	1341·2	− 6·9
Abborfors	60 30	26 30	1847.	71 19·8	71 49·0	450·0	1406·2	1335·9	1346·0	−10·1
Grönwick.........	60 33	27 30	1847.	71 32·3	72 1·5	441·1	1393·1	1325·0	1348·5	−23·5
Wiborg	60 44	28 50	1847.	70 51·6	71 20·8	446·2	1360·9	1289·4	1353·0	−63·6
Turkhauta	60 50	24 47	1847.	72 14·6	72 43·8	425·5	1395·1	1332·2	1346·5	−14·3
Tavastehus	61 0	24 28	1847.	72 8·4	72 37·6	427·6	1394·7	1331·1	1348·0	−16·9
Wilmanstrand ...	61 4	28 16	1847.	71 51·8	72 21·0	439·0	1410·2	1344·0	1356·1	−12·1
Imatra Fall	61 11	28 55	1847.	71 51·0	72 20·2	433·6	1411·3	1344·8	1357·6	−12·8
Huutjarwi	61 28	24 2	1847.	72 2·3	72 31·5	433·5	1405·8	1340·9	1352·9	−12·0
Pumala............	61 32	28 15	1847.	72 7·9	72 37·1	431·7	1406·9	1342·6	1361·7	−19·1
Wehuwarpe......	61 46	22 49	1847.	72 6·4	72 35·6	433·0	1409·3	1344·9	1353·8	− 8·9
Nyslott............	61 52	29 0	1847.	71 59·9	72 29·1	437·2	1414·6	1349·1	1367·3	−18·2
Tjök‡	62 18	21 23	1847.	72 43·0	73 12·2	419·4	1411·7	1351·3	1357·9	− 6·6
Warkauss-Sluss..	62 20	27 58	1847.	72 32·4	73 1·6	420·1	1400·1	1339·1	1371·0	−31·9
Johannisdal	62 21	21 21	1847.	73 27·3	73 56·5	399·4	1402·6	1347·9	1358·6	−10·7
Kuopio............	62 55	27 33	1847.	72 54·3	73 23·5	415·5	1413·6	1354·6	1377·2	−22·6
Wasa§	63 5	21 35	1847.	73 0·8	73 30·0	411·7	1442·0	1351·0	1367·6	−16·6

* In the garden near my house, and at different parts of the town and its environs; including differences of inclination of more than 1° 15′.

† H. F. very anomalous.

‡ Hansteen, 1825, $\Delta Z = -12{\cdot}4$.

§ Hansteen, 1825, $\Delta Z = -13{\cdot}3$.

Stations.	Lat. N.	Long. E.	Date.	Inclination. Observed.	Inclination. Reduced to 1830.	Horizontal Force.	Total Force.	Vertical Force. Observed.	Vertical Force. Calculated.	Vertical Force. Difference.
	° ′	° ′		° ′	° ′					
Sawojarwi	63 22	27 13	1847.	72 53·1	73 22·3	434·6	1511·1	1415·0	1383·0	+32·0
Sundby	63 36	22 40	1847.	73 18·9	73 48·1	401·8	1399·4	1343·9	1375·0	−31·1
Aho	64 2	26 27	1847.	73 24·9	73 54·1	407·4	1427·4	1371·5	1388·0	−16·5
Wirda	63 37	27 3	1847.	73 9·4	73 38·6	411·5	1420·1	1362·6	1384·6	−22·0
Salahmi	63 47	27 0	1847.	73 14·2	73 43·4	408·8	1417·2	1360·6	1386·6	−26·0
Kyrola	64 5	23 30	1847.	73 24·8	73 54·0	409·0	1432·7	1376·5	1382·6	− 6·1
Tuomala	64 25	26 0	1847.	73 30·7	73 59·9	410·7	1446·7	1390·7	1389·8	+ 0·9
Lassila	64 45	24 38	1847.	73 50·5	74 19·7	408·2	1466·9	1412·4	1393·0	+19·4
Uleaborg*	65 3	25 27	1847.	74 6·0	74 35·2	393·2	1435·2	1383·6	1398·6	−15·0
Wuornos	65 36	25 26	1847.	74 4·8	74 30·0	393·5	1434·7	1382·4	1405·3	−22·9
Rautiola	65 47	24 40	1847.	74 49·9	75 19·1	377·5	1437·9	1390·9	1405·2	−14·3
Tornea	65 52	23 30	1847.	74 52·3		380·2				
			1849.	48·4		2·6				
				74 50·3	75 19·5	381·4	1458·4	1410·9	1404·1	+ 6·8
Haaparanda† ...	65 52	23 30	1849.	74 28·1	74 57·3	382·1	1427·0	1378·1	1404·1	−26·0
Alkula ‡	66 20	23 49	1847.	74 21·1		392·2				
			1849.	15·2		3·8				
				74 18·2	74 47·4	393·0	1452·8	1401·9	1410·0	− 8·1
Toluanen ‡	66 36	23 52	1847.	74 31·9	75 1·1	386·9	1450·3	1401·1	1413·3	−12·2
Turtola‡	66 42	23 40	1847.	74 47·7	75 16·9	381·3	1453·9	1406·1	1414·5	− 8·4
Kardis Lappl.‡...	67 0	23 39	1847.	75 4·4	75 33·6	374·3	1452·9	1407·1	1418·0	−10·9
Kexiswaara‡ ...	67 15	23 27	1847	75 45·2	76 14·4	366·1	1487·8	1445·1	1420·6	+24·5
Muonionisca‡...	68 0	23 42	1847.	75 32·0		364·7				
			1849.	31·0		5·6				
				75 31·5	75 59·7	365·2	1459·1	1415·7	1430·2	−14·5
Kätkesuando‡...	68 7	23 22	1849.	75 32·1	76 1·3	359·8	1440·6	1397·9	1430·7	−32·8
Palajoensu	68 18	22 45	1849.	76 5·7	76 34·9	350·0	1456·7	1416·9	1432·5	−16·6
Kaaressuando ...	68 24	22 8	1849.	75 37·1	76 6·3	359·3	1446·6	1404·3	1433·7	−29·4
Kielli-jarwi	69 5	20 40	1849.	75 52·4	76 21·6	355·1	1455·0	1414·0	1439·0	−25·0
Tromsöe§.........	69 39	18 56	1849.	76 11·4	76 40·6	348·1	1458·4	1419·2	1444·4	−25·2
Hammerfest‖ ...	70 40	23 45	1849.	76 43·8	77 13·0	344·3	1500·2	1463·0	1464·0	− 1·0
Havösund¶	71 0	24 45	1849.	76 46·1	77 15·3	336·7	1471·0	1434·8	1466·1	−31·3
Kielwig Mageroe	70 57	26 15	1849.	76 54·6	77 23·8	333·7	1473·5	1438·0	1467·5	−29·5
Kitai-Insel** ...	68 28	38 30	1849.	75 50·6	76 9·6	358·2	1464·6	1422·0	1476·7	−54·7
Archangel†† ...	64 30	40 33	1849.	73 58·8	74 8·3	405·4	1468·9	1413·0	1439·1	−26·1
Bobrowsk	64 28	41 0	1849.	74 1·5	74 11·0	404·5	1469·6	1414·0	1440·8	−26·8
Kaduish	62 55	41 30	1849.	73 19·6	73 29·1	420·2	1464·5	1404·1	1422·8	−18·7
Plesskaja	62 35	40 55	1849.	72 46·7	72 57·2	429·8	1451·7	1387·9	1408·3	−20·4
Krassnowskaja...	62 10	40 10	1849.	72 33·5	72 43·0	432·8	1443·8	1378·7	1407·3	−28·6
Ustwelskoi	61 55	39 12	1849.	72 15·3	72 25·3	442·1	1450·6	1382·8	1400·4	−17·6
Kargopol	61 43	38 57	1849.	72 8·2	72 19·2	444·4	1448·6	1380·2	1395·7	−15·5
Badoshkaja	60 48	37 30	1849.	71 25·3	71 28·6	459·0	1440·8	1366·1	1381·1	−15·0
Wytegra	61 1	36 28	1849.	71 34·2	71 48·2	457·1	1445·9	1373·6	1380·5	− 6·9
Gomorowitschi...	60 55	34 35	1849.	71 34·4	71 53·0	450·6	1425·5	1354·8	1371·0	−16·2
Petersburg ‡‡ ...	59 56	30 18	1849.	70 33·2	70 59·0	473·1	1420·8	1343·2	1347·0	− 3·8

* Hansteen 1825, $\Delta Z = -12{\cdot}0$. † Hansteen 1825, $\Delta Z = -12{\cdot}1$.

‡ Hansteen 1825, $\Delta Z + 0{\cdot}1$; many iron mines in the vicinity; quantities of magnetic ironsand on the banks of Tornea river. § Keilhau, $\Delta V + 31{\cdot}2$.

‖ Sabine, $+2{\cdot}8$; Keilhau, $-30{\cdot}9$. ¶ Keilhau, $-27{\cdot}4$. ** Keilhau, $-3{\cdot}2$.

†† Reinicke and Mailander, $-62{\cdot}5$.

‡‡ Inclination observed by me; force by Kupffer; earlier observations gave $\Delta Z = -9{\cdot}3$.

In the above table, the horizontal force was obtained by vibrations, and reduced to 0° Reaumur. Before and after my journey in 1847, the force was determined at Dorpat by Gauss's method, and the needle employed compared therewith and reduced to the intensity in London=1372. Subsequently I preferred for trying the needles, Poisson's method, at least for traveling purposes; but some alterations require to be introduced in Poisson's formula, as he has overlooked some things. With the same needle which I employed in both my journeys, I have made more than 60 determinations of absolute force at Dorpat, partly in a room and partly in the open air, and in temperatures varying from −13° R. to + 25° R., and have found a very good accordance. I also made several such determinations in the journeys of 1848 and 1849.

As I do not possess an observatory, and cannot employ a Bifilar in my dwelling-house, it has not been possible for me to compare the variations of the force with my determinations; I have however made use of the following method:— If X be the magnetism of the earth and m that of the needle, I seek not X but m; this latter quantity depends on the temperature t and the time T, as the needle is not constant; but if I combine all the values of m by an equation of the form

$$m = \mathrm{A} + \mathrm{B}\, e^{-a\mathrm{T}} + e\,.\,t$$

and calculate the constants, the error is about $\frac{1}{600}\,m$. Besides this, several simultaneous observations with Gauss's apparatus have shown that the value of m was itself correct.

The Inclinations have in part been determined by two needles which agreed very well with each other; they are so balanced that I can always take the mean of the eight arcs. On the other hand they are subject to the error of the axle, which I cannot exactly correct, but which does not however exceed 5′. It was only last summer, when I examined the subject more closely, that I became aware you had likewise the idea of loading the needle, and observing in different azimuths. In our latitudes the best loading is such as will cause the north pole to be in one set about 10° above, and in a second set 10° below the horizontal line. Three series which I made with one needle were calculated by my friend Claussen, who in doing so was led to a method of entirely eliminating the form of the axle. Take a well-balanced needle, the axles of which are not cylindrical; different degrees of magnetic force can be given to it without reversing the poles. Taking the strongest force as unity, it is not practically advantageous to go to lower ratios than $\frac{1}{4}$ or $\frac{1}{8}$. Though vibration experiments with dipping-needles are not generally advantageous, yet they suffice in this case, as an approximately correct proportion of the intensities is all that is wanted. It is sufficient to make, with each degree of intensity, the two observations with the face east and face west, without reversing the needle on its supports; if the latter is done, it gives a second determination, affording a check upon the first. You will then find that the mean of the two observations in one position of the axles is less than the

true inclination, and in the other position greater; the difference in both cases being more considerable as the intensity of the needle is weaker. Let I_0, I_1, I_2, &c. be the inclination observed with different intensities; T_0, T_1, T_2, &c. be the times of vibration, which increase as the index increases; a small correction is required, which can be determined in the following manner.—Take either I_0 or a somewhat less value (in round minutes) as being nearly correct, and let

$$I_0 - I_1 = \Delta I_1, ; I_0 - I_2 = \Delta I_2, \&c.,$$

then

$$\Delta I = x + T^2 y ;$$

x being the correction; thus I found

Az. 0°; I=70° $23'{\cdot}8$. Az. 180°; I=71° $26'{\cdot}5$. Mean 70° $55'{\cdot}1$. T=$1^s{\cdot}167$.
Az. 0; I=70 48·7. Az. 180; I=71 44·7. Mean 71 15·2. T=1·738.
Az. 0; I=66 16·0. Az. 180; I=84 16·5. Mean 75 36·3. T=4·25.

If I take 70° $55'{\cdot}0$ as nearly correct, I obtain the three following equations;

$$0'{\cdot}1 = x + (1{\cdot}167)^2 y \;;\; 20'{\cdot}2 = x + (1{\cdot}738)^2 y \;;\; 281{\cdot}3 = x + (4{\cdot}25)^2 y.$$

The three equations have not however the same weight, as the directive force is less in proportion as T is larger; in order to give them all the same weight I divide each by the coefficient of y, and thus obtain in logarithms

$$8{\cdot}86586 = 9{\cdot}86586\,x + y \;;\; 0{\cdot}82525 = 9{\cdot}51990\,x + y \;;$$
$$1{\cdot}19239 = 8{\cdot}74322\,x + y.$$

and hence $x = 21'{\cdot}8$; and the true dip=70° $33'{\cdot}2$.

I have here taken an imperfect needle, which I also observed in Azimuths of 30° to 30°; in one position of the axles I obtained 70° $39'{\cdot}5$; $\pm 5'{\cdot}9$; and in a second 70° $42'{\cdot}5$; $\pm 5'{\cdot}4$; mean 70° $41'{\cdot}0$. On a subsequent day I observed with a second needle and obtained 70° $43'{\cdot}4$; but an independent needle gave a dip $2'{\cdot}6$ greater, so that the two determinations are 70° $42'{\cdot}1$, 70° $42'{\cdot}3$, if we add to each the half difference.

In this method, in which no reversal is needed, the differences of the partial determinations will appear somewhat large, but you must not forget that instead of the ordinary eight observations only two have been taken.

I permit myself one additional remark. In observations on different azimuths, it is usual to take simply $\cot I = \cot I_1 \cos \alpha$; in latitudes where the dips are so high as here and in England, this equation may be employed without much error, as the force in azimuths perpendicular to the meridian is little less than in the meridian; but it is quite otherwise in small dips. With the decrease of force the possibility of error increases, and hence when the observations made in different azimuths are combined as by Kupffer, they have not the same weight. In more exact determinations I employ the following method.

Let K be the total, H the horizontal, V the vertical force, and α the nearly known azimuth; then

$$\mathrm{K} \cos \mathrm{I} = \mathrm{H} \cos \alpha ; \ \mathrm{K} \sin \mathrm{I} = \mathrm{V} ; \ \tan \mathrm{I} = \frac{\mathrm{V}}{\mathrm{H}} \cdot \frac{1}{\cos \alpha} ;$$

whence $$d\,\mathrm{I} = \frac{\cos^2 \mathrm{I}}{\cos \alpha}\, d \left(\frac{\mathrm{V}}{\mathrm{H}}\right) + \frac{\mathrm{HV}}{\mathrm{K}^2} \sin \alpha \,.\, d\,\alpha .$$

If on the right we substitute for $\cos^2 \mathrm{I}$ its value, then

$$d\,\mathrm{I} = \frac{\mathrm{H}^2 \cos \alpha}{\mathrm{K}^2}\, d \left(\frac{\mathrm{V}}{\mathrm{H}}\right) + \frac{\mathrm{HV}}{\mathrm{K}^2} \sin \alpha\, d\,\alpha .$$

As the possibility of error is inversely as the force, I multiply the equation by K, to give to the different determinations equal weight, thus

$$\mathrm{K}\, d\,\mathrm{I} = \frac{\mathrm{H}^2 \cos \alpha}{\mathrm{K}}\, d \left(\frac{\mathrm{V}}{\mathrm{H}}\right) + \frac{\mathrm{HV}}{\mathrm{K}} \sin \alpha\, d\,\alpha :$$

having determined the dips in the customary manner with the approximately known values of α, I obtain the values d I, which serve to find $d\left(\frac{\mathrm{V}}{\mathrm{H}}\right)$; *i. e.* the correction of I.

I possess now with my instrument six needles, which I hope to compare very accurately with each other in the course of this year; but some months must first elapse, as I make all these determinations in the open air, and the bad autumn we have had has interrupted me in the work. I have had two of my needles fitted according to Fox's method, with wheels on their axles; two others have brass indexes, as was formerly proposed by Bernoulli and Euler (Berlin Trans. 1755), and I can now determine the absolute intensity with the inclinatorium. I know Fox's method only from a short notice in the London and Edinburgh Phil. Mag.; if I do not mistake, he proposed also to determine the declination by the same apparatus. With ordinary needles there remains an uncertainty. If we load the S. end of the needle so that the N. end is about 10° above the horizon, the S. end sinks down; and if we seek the azimuth in which the needle is perpendicular and then observe at about half a degree of azimuth on either side, the inclination alters so rapidly with the azimuth, that I have thus been even able to follow the diurnal variations of the declination; and the magnetic meridian may thus be determined for the observations of absolute declination whilst travelling.

I will not trouble you further as my letter is already so long, and will only add one request. The Phil. Trans. arrive here rather late, and the last communications which I have seen of yours contain Keely's determinations. All the observations of the Erebus and Terror have not yet appeared; in the Atlantic I know only the total intensities but without inclinations or declinations, and yet I am very anxious for some determinations that have been made between 10° and 20° of longitude in the higher latitudes to compare my calculations with them. If your time permits, I should be very much obliged

to you if you could communicate to me the inclination and force at some points. In the mean time I will occupy myself with the discussion of the two horizontal forces; unfortunately the number of determinations serving for this purpose is much smaller. For North America those recorded by Lamont in Dove's 'Repertorium' are for the most part in comparatively low latitudes.

May 1, 1851.

The EARL OF ROSSE, President, in the Chair.

A paper was read, entitled "An account of two cases in which an Ovule, or its remains, was discovered after death in the Fallopian tube of the unimpregnated human female, during the period of Menstruation." By H. Letheby, M.B. Communicated by W. B. Curling, Esq., F.R.S. Received Feb. 20, 1851.

At the commencement of the paper the author refers to the opinions of Drs. Power, Lee, Paterson, Barry, Girdwood, and Wharton Jones of this country, and also to those of MM. Valentin, Negrier, Pouchet, Gendrin, Raciborski, and Bischoff on the continent, respecting the supposed nature of the physiological phenomena manifested during the peirod of menstruation; and he mentions the law of Bischoff, namely, that "the ova formed in the ovaries of the females of all mammiferous animals, including the human female, undergo a periodical maturation and exclusion quite independently of the influence of the male seminal fluid. At these periods, known as those of 'heat' or 'the rut' in quadrupeds, and 'menstruation' in the human female, the ova which have become mature, disengage themselves from the ovary and are extruded. If the union of the sexes takes place at this period, the ovum is fecundated by the direct action of the semen upon it, but if no union of the sexes occurs, the ovum is nevertheless evolved from the ovary, and enters the Fallopian tube where it perishes." He states, however, that the arguments which have been advanced in support of this opinion in respect of the human female, are entirely of an analogical character; and that although the ovaries of women who have died during the menstrual period have been frequently examined, and Graafian follicles found in a recently ruptured state, yet the discovery of the liberated ovule had not, so far as the author was aware, ever been detected. The importance of his cases rests upon three grounds, namely,—1st, the circumstances under which the women had died; 2ndly, the finding of recently ruptured Graafian follicles; and 3rdly, the discovery of the ovule and its remains in the fluid matter of the Fallopian tubes.

In the first of the cases recorded, the woman died during a menstrual period. She had been an inmate of the London Hospital for twenty-four days before her death, where she was closely watched day and night by a nurse, in consequence of her having attempted